CHAPTER 3

THE DATA DISPLAY GROUP AN/UYA-4(V)

INTRODUCTION

The majority of maintenance actions performed on the Combat Direct System (CDS) involve the tactical display system. Tactical display systems have been in use as part of the Naval Tactical Data System (NTDS) since the late 1950s. During this time, the design of the tactical display system has evolved and undergone many modifications and improvements. This chapter will introduce you to the Data Display Group AN/UYA-4(V).

After completing this chapter you should be able to:

- **State the purpose of the Data Display Group AN/UYA-4(V)**
- **Describe the relationship between the Data Display Group AN/UYA-4(V) and the Combat Direction System**
- **Describe the sensor data signal flow in the Data Display Group AN/UYA-4(V)**
- **Describe the basic operation of the radar azimuth converter**
- **Describe the function of the radar data distribution switchboard**
- **Describe the signal flow of tactical data between the Combat Direction System computer and the Data Display Group AN/UYA-4(V)**
- **Describe the purpose and operation of the pulse amplifier/symbol generator**
- **Describe the functional operation of the plan position indicator**
- **Describe the functional operation of the video signals simulator**
- **Describe the function of the test message generator**

The overall requirement of any tactical display system is to provide a visual display of the real-time deployment of ships and aircraft, the tactical situation, and the geographical area of the situation.

To perform this requirement, the display system must be able to accomplish several functions. These system functions include:

- Sensor data distribution and display
- Tactical data distribution and display
- Data display group simulation and testing

The Naval Tactical Data System (NTDS) has evolved into the Combat Direction System (CDS). Through this evolution, the function and design of the tactical display system has remained fairly constant. On ships with the AN/UYA-4(V) display group, the basic equipment and signal flow are as shown in figure 3-1.

The block diagram can be split into three functions: sensor data, tactical data, and simulated data. Each of these functions ties together at the display console. In the this chapter, we look at each function and how it affects the picture on the display console.

SENSOR DATA DISTRIBUTION AND DISPLAY

Sensor data originates with the ship's sensors (radar, sonar, and IFF) and is ultimately displayed as sweep and video on the display console as shown in figure 3-1. Sensor data normally consists of two types of data: **antenna position** and **video signals.**

Antenna position data as it originates from the ship's sensors must be converted to a form usable by the AN/UYA-4(V) display consoles. Conversion of the sensor antenna position data is accomplished by radar azimuth converters (RACs) or sonar azimuth converters (SACS). In this chapter, we only discuss the operation of a RAC. One converter is required for each of the ship's sensors. The RAC outputs the timing signals and X/Y quantities necessary to generate that radar sweep display. The sweep data is fed from the RAC to the radar data distribution switchboard (RDDS) for distribution to the consoles.

Video signals are fed from the sensor or sensors to the RDDS and then to the consoles. The sweep generation logic of the consoles and timing signals from the RAC ensure that the intensified video is displayed at the proper range on the plan position indicator (PPI) sweep.

RADAR AZIMUTH CONVERTER (RAC)

The radar azimuth converter, or RAC, converts position data from each of the ship's radars into a digital quantity usable by the display console and the computer. The antenna position data coming into the RAC maybe in synchro or digital form, depending on the characteristics of the radars installed on the ship. The RAC develops a series of signals known as ΔY and ΔY pulse trains and the sign of ΔX and sign of ΔY to send to the display console to paint the sweep in the proper position. The RAC also develops a digital data word that contains the azimuth of the antenna that is transferred to the CDS computer. This data word is known as digital theta and is represented by the Greek letter theta (θ).

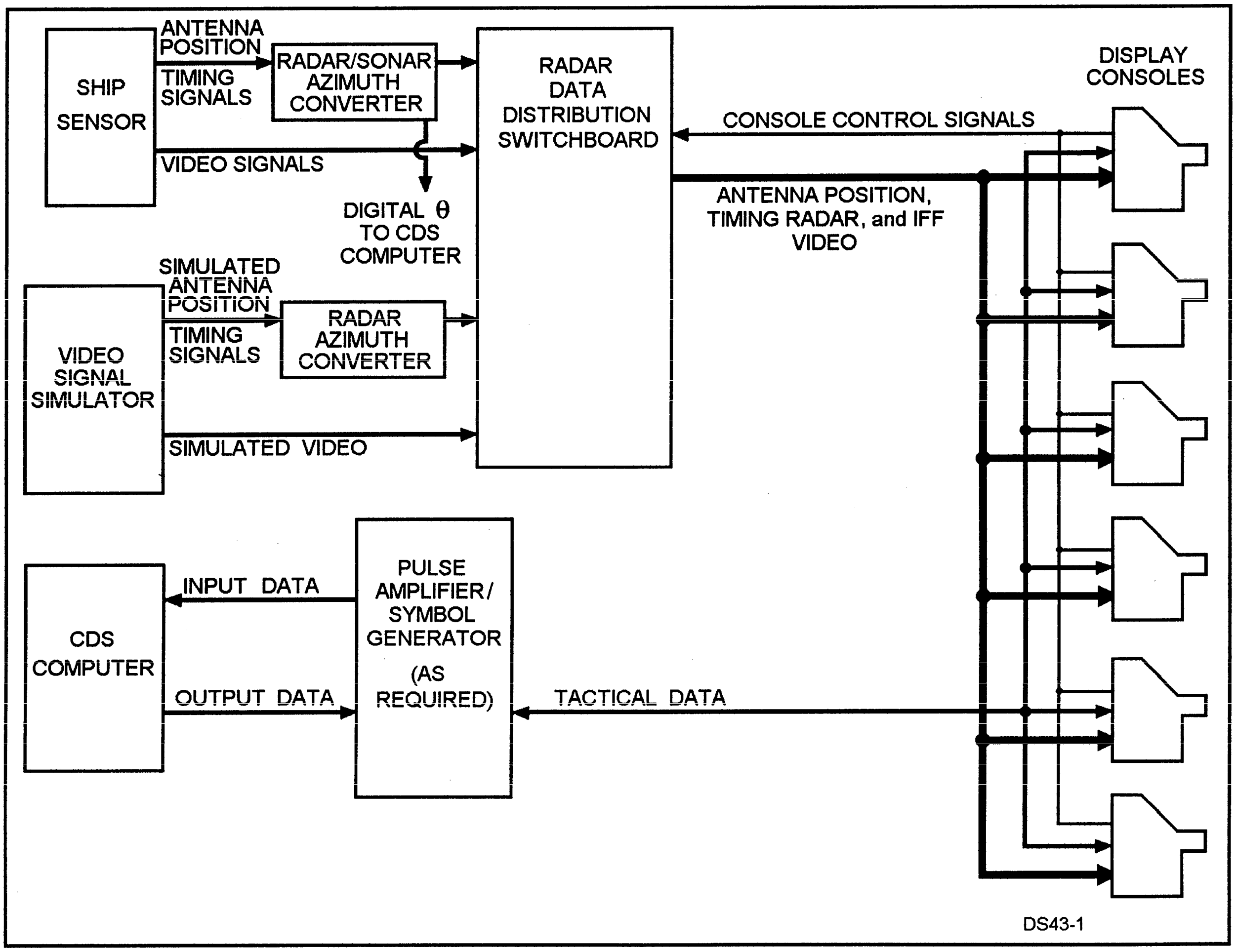

Figure 3-1.—The AN/UYA-4(V) data display system.

The ΔX and ΔY pulse trains are generally developed by using the sine and cosine of the antenna angle. The sine and cosine of the antenna angle will define the angle in a 90-degree quadrant. The sign bits (sign of ΔX, sign of ΔY) will determine in which quadrant the sweep will repainted. The quadrants and required sign bits are illustrated in figure 3-2.

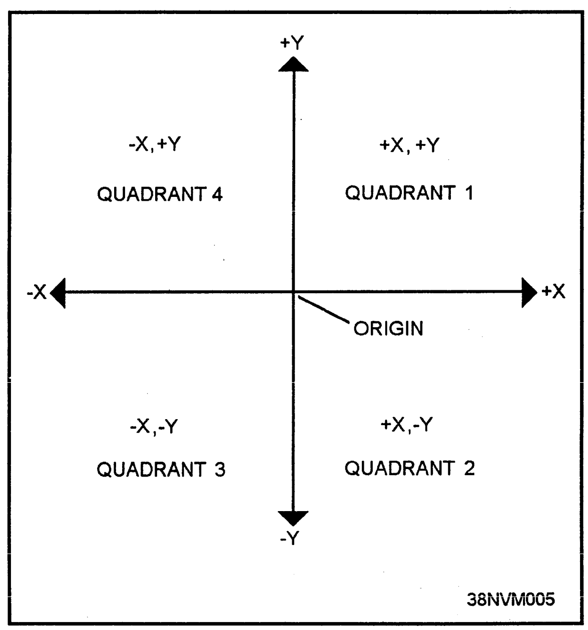

Figure 3-2.—The X/Y quadrants of a CRT.

The ΔX and ΔY pulse trains are sent to the display console where they cause a pair of digital counters to increment one time for each pulse. The number of pulses between the zero mile range mark (start of sweep) and the end of sweep signal denotes the radar sweep angle, and the spaces between pulses indicate the range of the sweep. For example, the sine and cosine of 45 degrees are equal to each other. To paint a sweep at 45 degrees, the sign of ΔX and the sign of ΔY will both be positive indicating quadrant one. In developing the ΔX and ΔY pulse trains, the number of pulses for each would be equal. This will increment the sweep counters in the display console at the same rate. The output of the sweep counters is continuously fed to the deflection circuitry, and the beam will be deflected at 45 degrees.

Figure 3-3 shows the front panel of a typical RAC. The RACs installed on your ship may not look exactly like this one. On this particular RAC panel, internal testing is accomplished by using the MODE SELECTOR switch. Most RACs have a similar MODE SELECTOR switch that operates in the same basic manner. When the MODE SELECTOR switch is in the OPERATE position, the RAC operates with its radar. The other switch positions of the front panel are used for maintenance and troubleshooting as shown in table 3-1.

The RACs are combined together into a cabinet or cabinets called the radar azimuth converter group. The cabinets provide a common power supply and mountings for several RACs. The output of the RACs are fed to the radar data distribution switchboards (RDDSs).

Table 3-1.—The MODE SELECTOR Switch Functions

MODE SELECTOR Switch Position	Function
OPERATE	Normal mode, RAC is driven by external sensor signals.
$\Delta\theta$ STEP	RAC increments one $\Delta\theta$ every time the $\Delta\theta$ RESET CP (clock pulse) pushbutton is depressed.
RESET	Resets the RAC bearing to zero when the $\Delta\theta$ RESET CP pushbutton is depressed.
CP STEP	RAC generates one clock pulse every time the $\Delta\theta$ RESET CP pushbutton is depressed.
CONTINUOUS	RAC will generate a continuous simulated radar sweep, independent of radar signals.

RADAR DATA DISTRIBUTION SWITCHBOARD (RDDS)

The radar data distribution switchboard (RDDS) routes radar and sonar antenna position data and timing signals from the sensor RACs to the display consoles. It also receives up to four separate video signals (video levels) directly from each sensor.

The RDDS provides the display consoles access to all the sensors connected to the switchboard. The RDDS can accept inputs from 11 radar or sonar sensors and provide outputs to display consoles on 10 output channels, one standard display console per

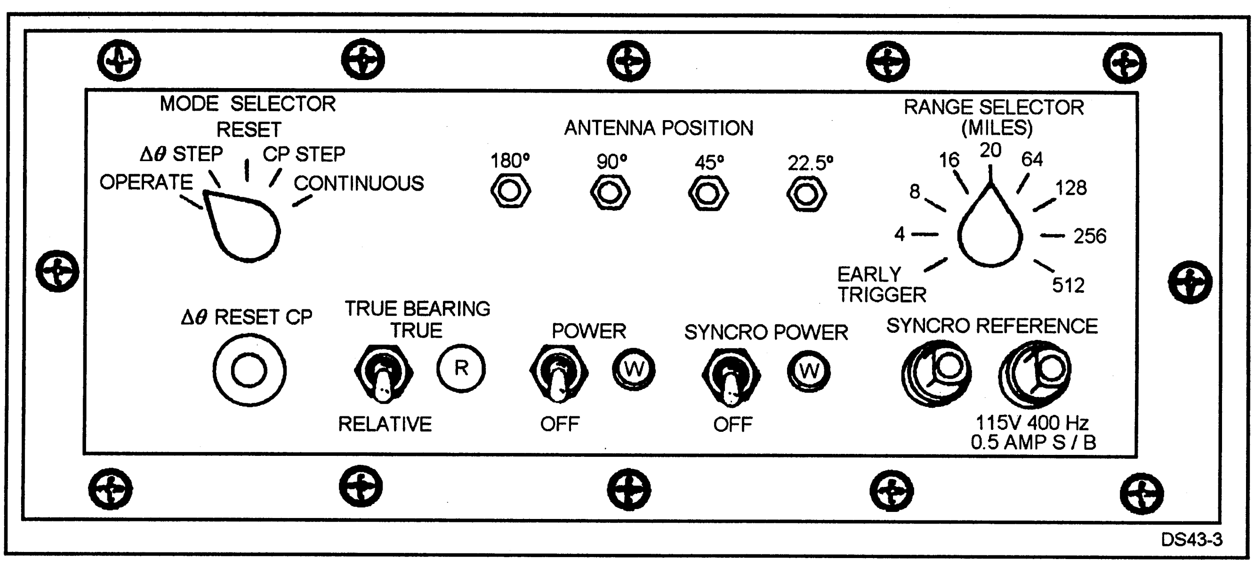

Figure 3-3.—A typical RAC front panel.

channel. Each of the ship's sensors can be connected, in parallel, to four switchboards to provide sufficient outputs for each display console in the system.

Figure 3-4 shows the front panel of the RDDS. When the VIDEO SELECT or RADAR SELECT switches are in the REMOTE position, switching circuits within the RDDS allow the display console on an output channel to select any of the sensors inputting to the RDDS as the source of its sensor display. The display consoles select the sensor (radar/sonar) and video level by sending control signals to the RDDS. In the event of a console control signal problem, manual selection of sensor and video may be performed at the RDDS front panel.

TACTICAL DATA DISTRIBUTION AND DISPLAY

Tactical data is digital data received from or transmitted to the CDS computer. Tactical data from the computer (output data) is used by the display system to generate symbol displays and alert/switch indications on the display consoles and alphanumeric displays on the digital display indicator (DDI), also called the auxiliary cathode readout (ACRO). Tactical data going to the computer (input data) results from operator actions (switch depressions, trackball movement, and so forth) at the display consoles.

Figure 3-5 illustrates the data path of tactical data. This data path can vary depending on the type of system installed on your ship. Systems using the console internally generated and refreshed symbols (CIGARS) modification will not have a separate symbol generator. Systems using the direct computer interface (CDI) CIGARS consoles will not have the pulse amplifier/symbol generator.

In this section, we examine the format of the different data words and messages used by the CDS system. This is followed by' a brief description of some of the equipment used to display tactical data.

COMPUTER DATA WORD FORMATS

This section describes the contents and functions of the computer words outputted to the display

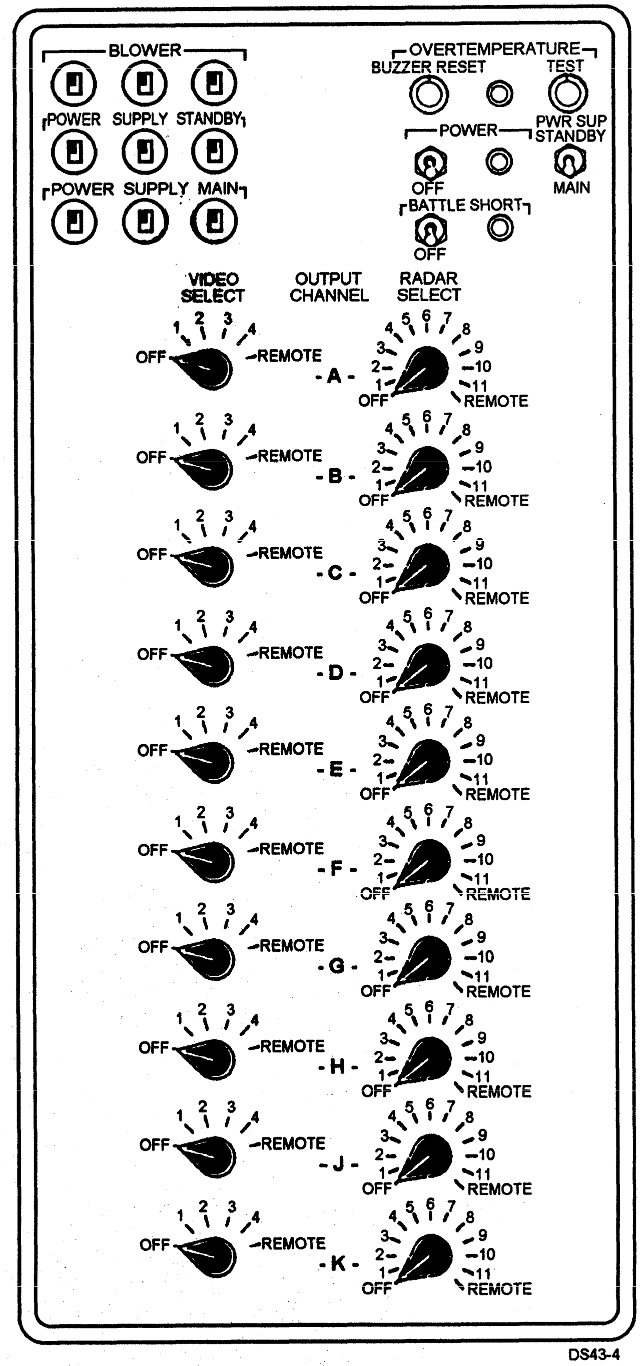

Figure 3-4.—The RDDS front panel.

consoles.

External Function (EF) Word

The external function (EF) word is used to interrogate the addressed console for input data. In addition, for CIGARS consoles, portions of the word

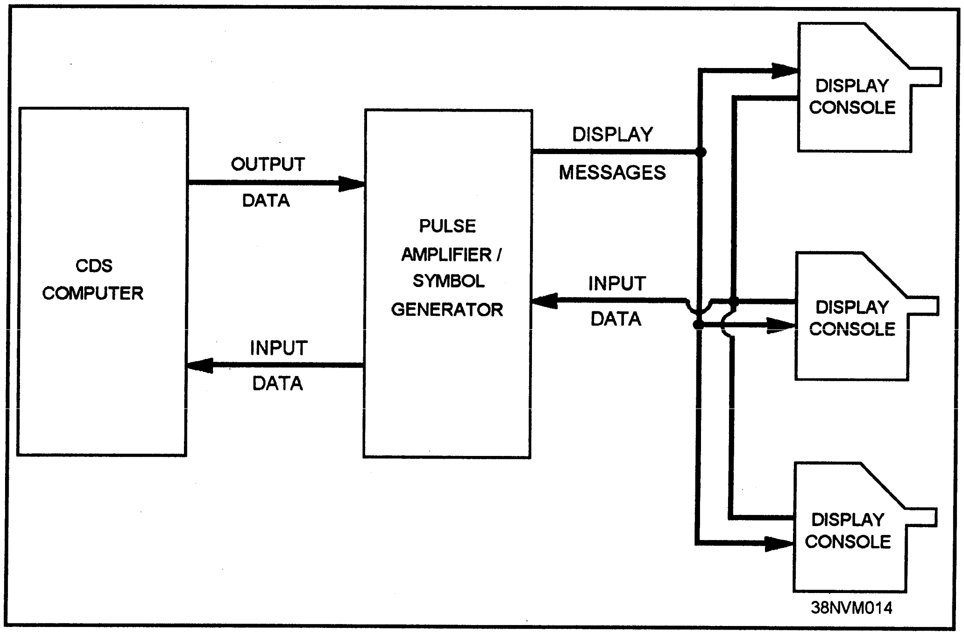

Figure 3-5.—The tactical data path.

are used for CIGARS memory load commands. The format of the external function word is shown in figure 3-6.

Input Data Words

The input data words are formed by the display console logic based upon operator actions. Most operator switch closures or changes will result in the generation of an input word. When the console receives an interrogation EF, the console inputs the input data word to the computer via the pulse amplifier (PA) or direct computer interface (DCI).

Each data word sent to the computer consists of a six-bit function code (lower six bits) with the remainder of the word dedicated to data amplifying the function as shown in figure 3-7. For instance, a function code of 00 (binary coded octal) with all zeros in the amplifying data indicates no new data since the last interrogation (no operator switch actions since the last interrogation). A function code of 01 indicates the trackball is enabled. The amplifying data indicates the coordinates of the trackball and range selection of the console.

Input data words are developed for the console display control panel and communication panel switch closures, for the trackball and its control switches, and for the digital data entry unit (DDEU) and computer-controlled action entry panel (CCAEP) switches.

Output Data Word Types

The contents and functions of the computer words generated by the CDS computer and outputted to the

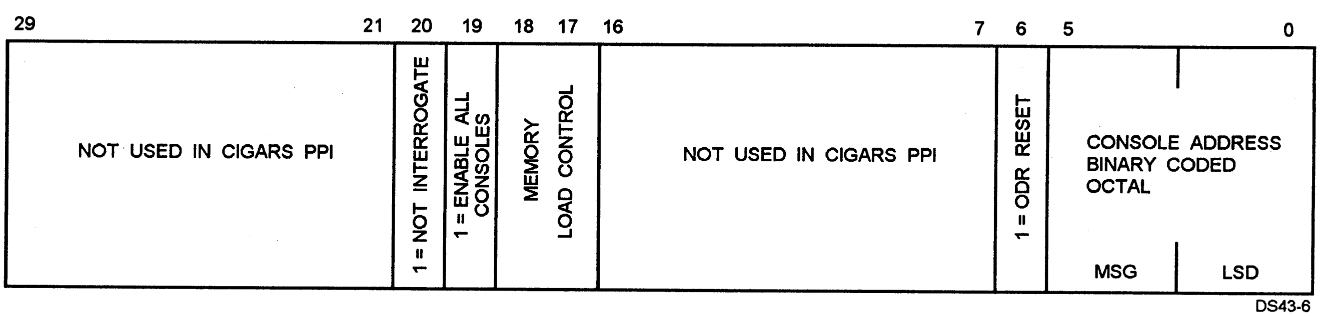

Figure 3-6.—The external function (EF) word format.

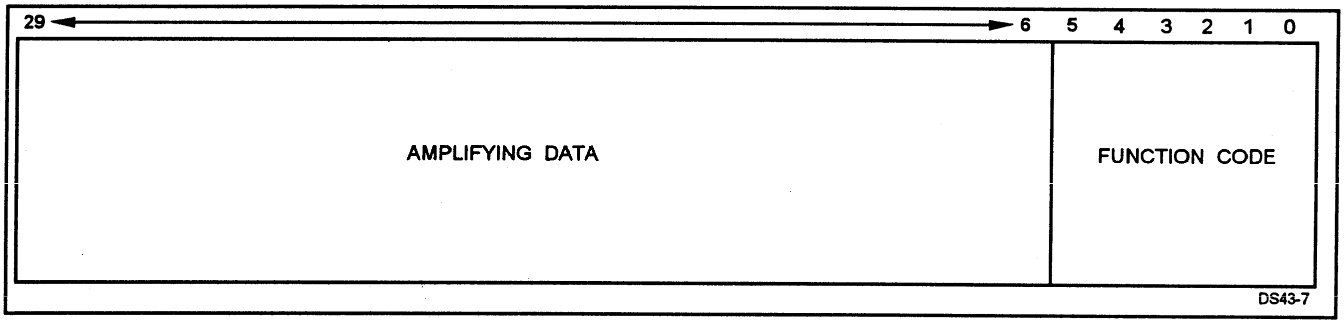

Figure 3-7—The input data word format.

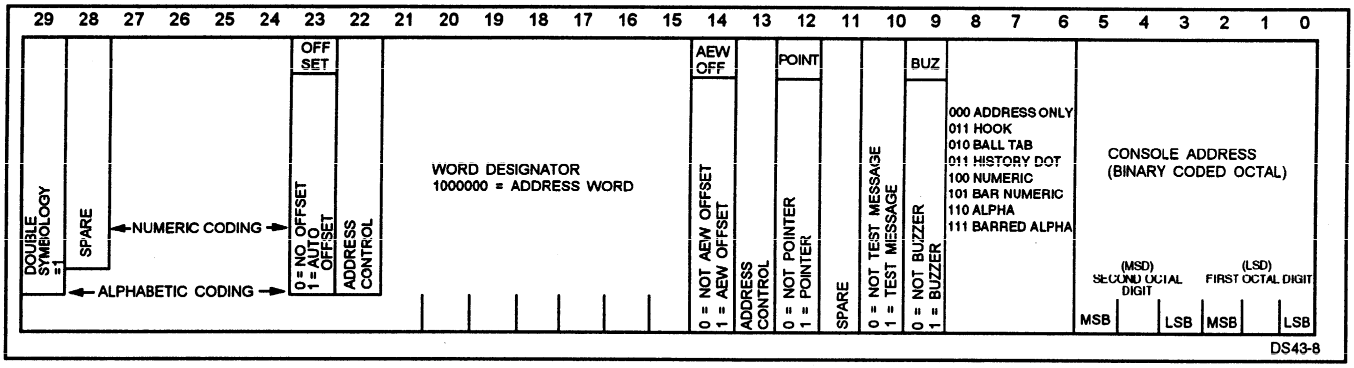

Figure 3-8.—The address word format.

display group are described in the following paragraphs.

ADDRESS WORD.— The address word performs two major functions. It addresses or excludes a particular console from acting on the following message data, and it forms the first word of addressed display messages.

The address word format is shown in figure 3-8 and contains the address word designator (bit $2^{21}=1$ and bits 2^{20} to $2^{15}=0$), the console address of the console (bits 2^5 through 2^0) to be addressed or excluded, symbol type definition, PPI buzzer commands, auto offset commands, and double symbology commands.

VELOCITY/CATEGORY (V/C) WORD.— The velocity/category (WC) word identifies the type of symbol, line, or circle to be displayed. For symbols, the length and type of velocity leader (indicating direction and speed of movement) are specified. One inch of leader indicates 1,080 knots speed for an air track or 33.8 knots for a sea (surface/ subsurface) track.

The V/C word format is shown in figure 3-9. It contains the word designator, velocity leader data including scale factor, type (air/sea), X/Y velocity, and symbol data. The symbol data includes category/subcategory, auto/manual and local/remote status, threat, identity, and engagement status.

When the V/C word is used-to define a line, the word will indicate if the line is to be solid or dashed.

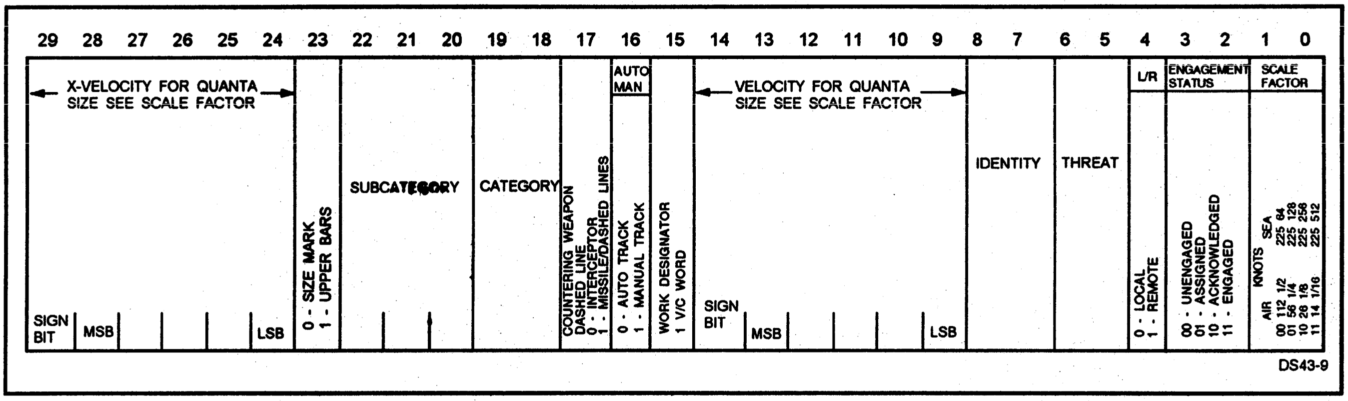

Figure 3-9.—The velocity/category word format.

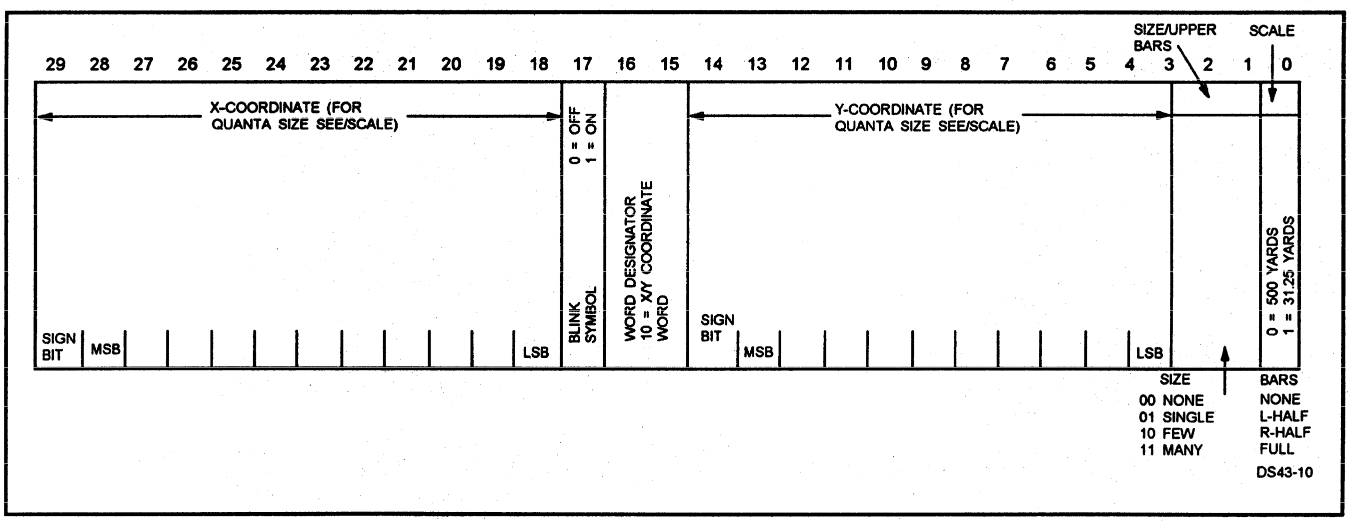

Figure 3-10.—The X/Y coordinate word format.

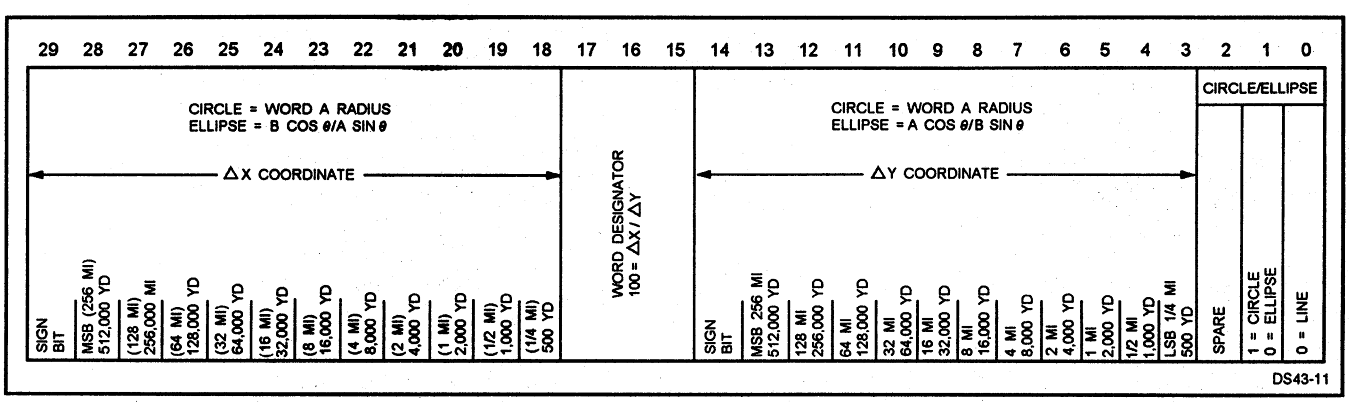

Figure 3-11.—The ΔX/ΔY coordinate word format.

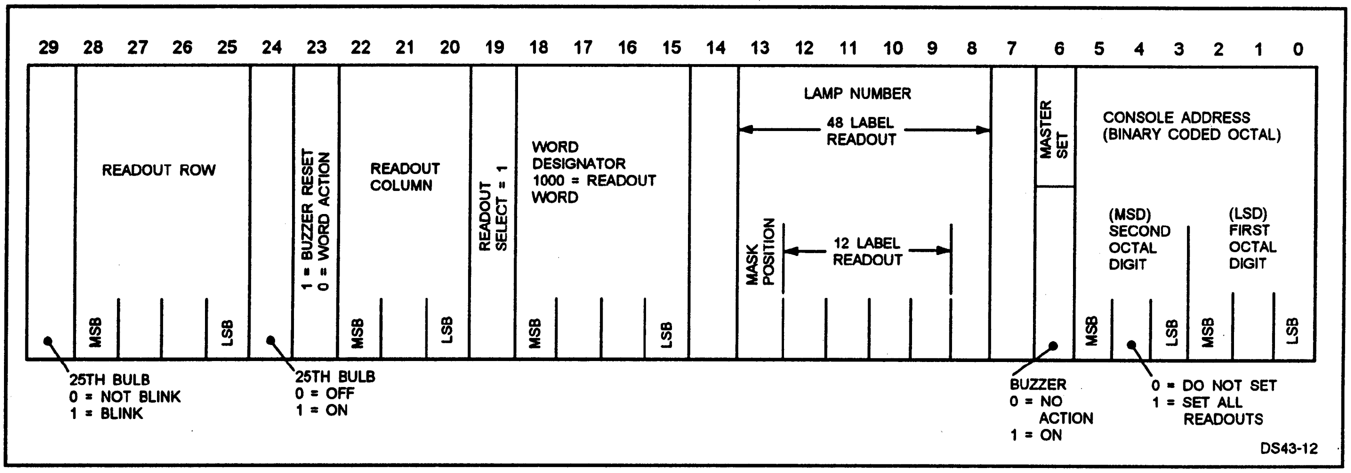

Figure 3-12.—The 48-label readout word.

X/Y COORDINATE WORD.— The X/Y coordinate word format is shown in figure 3-10. It is used to define a point on the CRT X/Y grid. This point may be one of the following: the center point of a symbol or circle, the starting point of a line, or the amount of offset in the display. In addition, the word provides symbol modifier (size/upper bar position) and blink (2Hz) commands.

ΔX/ΔY WORD.— The ΔX/ΔY word is shown in figure 3-11 and is used with lines and circles/ellipses. When used with lines it defines the length and direction of the line. When used with circles/ellipses it defines the major and minor axis radii.

48 LABEL READOUT WORD.— The 48 label readout word is shown in figure 3-12 and is used to illuminate the computer controlled action entry panel (CCAEP) 48 label readouts. It defines the switch row and column, and the lamp number. It may also be used to energize or reenergize the PPI buzzer.

Message Format

Output messages to the display consoles are composed of one or more of the computer words we have already discussed. Each message is designed to define a particular display function. Figure 3-13 lists the display message types and indicates the computer words, in order, that compose the particular messages.

NORMAL MESSAGE.— This message is generated by the computer to locate and describe a particular track symbol and velocity leader to all the consoles. The X/Y coordinate word provides the information to position the symbol on the CRT. The V/C word provides the velocity, category, identity, and engagement status of the symbol, As the message is not addressed to any particular console, the console category selection switching is used to control the symbol display.

ADDRESSED NORMAL MESSAGE.— This message is the same as a normal message except that it is preceded by an address word to address the message to a particular console.

ALPHANUMERIC, HOOK, BALLTAB, HISTORY DOT, AND POINTER MESSAGES.— These addressed messages consist of an address word and an X/Y coordinate word. They are designed to display the particular alphanumeric, bar alphanumeric, or indicated symbol on the addressed console only.

LINES MESSAGE.— This message is designed to draw a line on the PPI display. The message consists of a ΔX/ΔY coordinate word to define the slope and length of the line, an X/Y coordinate word to specify the starting point, and a V/C word to identify the type of line.

ADDRESSED LINES MESSAGE.— This message (not shown) is the same as the lines message except that it is preceded by an address word to address the message to a particular console.

STANDARD CIRCLES MESSAGE.– This message is used to display one of the 13 types of standard circles. The X/Y coordinate word specifies the center of the circle and the V/C word defines the type of circle and therefore its diameter. The standard circles message may be addressed to a particular console.

PROGRAMMABLE CIRCLES AND ELLIPSES MESSAGE.— This message generates up to 512 different diameter circles and ellipses. The circle message consists of a circle word (modified ΔX/ΔY coordinate word) which defines the A and B radius of the circle, an X/Y coordinate word that defines the center of the circle, and a V/C word that defines the type of circle.

The ellipse message consists of two ellipse words that define the major and minor axis and angle of inclination of the ellipse, an X/Y coordinate word that defines the center of the ellipse and a V/C word that defines the type of ellipse.

Both programmable circle and ellipse messages may be addressed to a particular console.

OFFSET MESSAGE.– The offset message offsets the display of sweep and symbols to any position on the CRT if the console operator has selected OFFSET on his console. The X/Y coordinate word indicates the amount of offset to the addressed console.

PULSE AMPLIFIER/SYMBOL GENERATOR (PA/SG)

The PA/SG is actually two pieces of equipment in one cabinet. Several different configurations of this equipment are available and the one installed with your system is dependant on the type of display consoles on the ship. The basic AN/UYA-4(V) system uses the PA/SG configuration. Systems with the CIGARS modification installed will have the pulse amplifier but not the symbol generator. Systems with CIGARS and direct computer interface (DCI) will not have a PA/SG.

- NORMAL MESSAGE
  - X/Y coordinate word
  - V/C word
- ADDRESSED NORMAL MESSAGE
  - Address word
  - X/Y coordinate word
  - V/C word
- ALPHANUMERIC, HOOK, BALL TAB, HISTORY DOT, and POINTER MESSAGES
  - Address word
  - X/Y coordinate word
- LINES MESSAGE
  - ΔX/ ΔY coordinate word
  - X/Y coordinate word
  - V/C word
- STANDARD CIRCLES MESSAGE
  - X/Y coordinate word
  - V/C word
- PROGRAMMABLE CIRCLES MESSAGE
  - ΔX/ ΔY coordinate word
  - X/Y coordinate word
  - V/C word
- PROGRAMMABLE ELLIPSES MESSAGE
  - ΔX/ ΔY coordinate word
  - X/Y coordinate word
  - V/C word
- OFFSET MESSAGE
  - X/Y coordinate word

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Figure 3-13.—Display messages.

Pulse Amplifier

The pulse amplifier (PA) provides for the amplification and distribution of computer input and output data between the display consoles and the

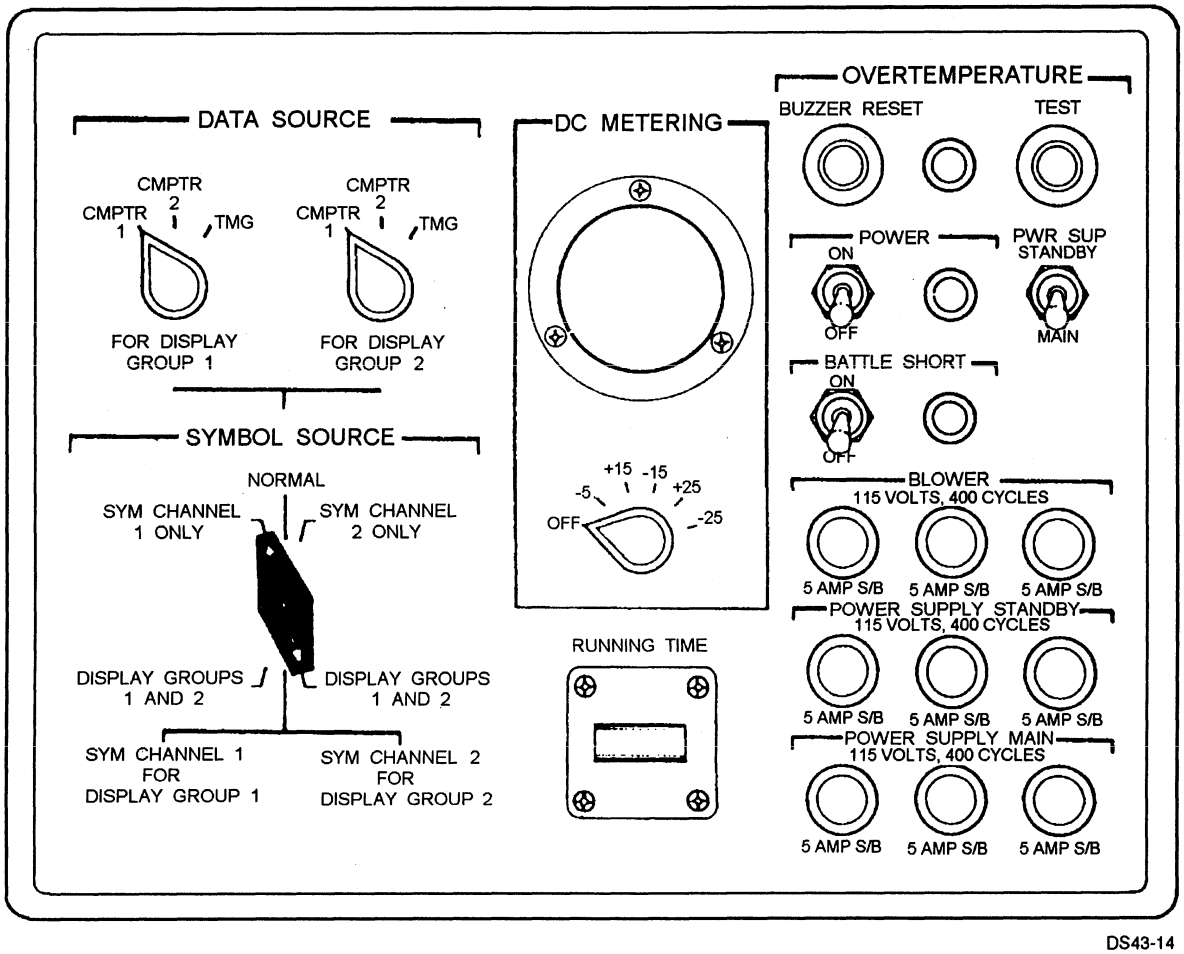


Figure 3-14.—The PA/SG front panel.

CDS computer. Display consoles in tactical systems are divided into two or more display groups, with up to ten consoles in each group.

PAs come in three configurations: single channel, dual channel, or 4-channel. A single channel CPA can interface with one computer and one display group. A dual channel CPA interfaces two computers with two display groups, and a 4-channel CPA interfaces up to 4 computers with 4 display groups.

Symbol Generator

For those systems using waveform symbol generators, there is one SG for each output channel of the PA. A single symbol generator can drive two display groups in the event of malfunctions. In a dual channel PA either computer channel or SG can be used to control both display groups. This switching arrangement allows the display to be divided for maintenance (one group for normal operations, and one group for testing) or controlled from one computer for normal operations or system level testing.

Figure 3-14 shows the front panel controls for a dual channel PA/SG. The DATA SOURCE switches control the computer and TMG (test message generator) selection for the two display groups (1 or 2). The SYMBOL SOURCE switch controls the configuration of the symbol generators. In the NORMAL position, each of the two SGs drive one display group.

The symbol generator can uses analog waveforms or digital strokes to generate symbols. The methods of symbol generation (analog or digital) are covered in chapter one of this training manual.

PLAN POSITION INDICATOR (PPI)

The plan position indicator (PPI), or display console, is the heart of the tactical display system. The PPI console allows its operator to view the inputs from the ship's sensors (radar/sonar/IFF) and tactical symbology, to operate in the desired program mode, and to communicate by voice with other consoles, ship's spaces, or remote ships and aircraft.

The PPI display consoles you will encounter in the fleet come in several system and design variations. The PPI console shown in figure 3-15 is a typical PPI. Although we highlight the features of several different consoles in this section, some areas discussed may not be applicable to the consoles on your ship.

The display console provides an operator (seated) with up to a 2,000-symbol tactical display on a 10.7-inch-diameter CRT. Amplifying alphanumeric information is provided by up to two IP-1304 DDIs mounted on top of the console.

Each water-cooled console contains its own high-voltage and low-voltage power supplies. The high-voltage power supply (hvps) provides the voltages necessary to drive the 10.7-inch CRT. The low-voltage power supply (Ivps) provides for the logic power and lamp indicators. The console microprocessors and other logic are located in the card box beneath the console bullnose.

Front Panel Controls and Indicators

The console control panels are shown in figure 3-16. The display, CRT controls, and data entry devices are located for ease of use and maximum flexibility in the console operation.

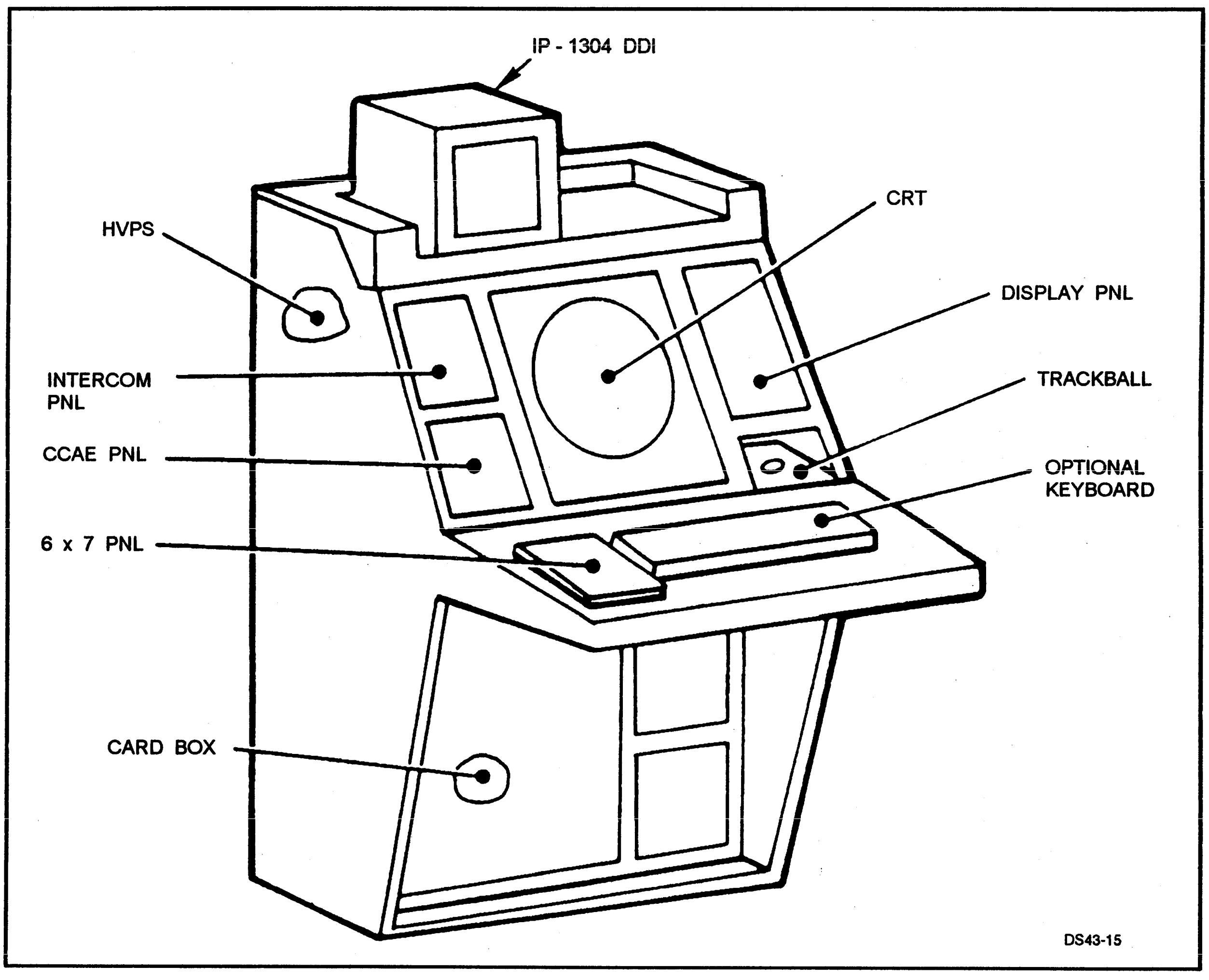
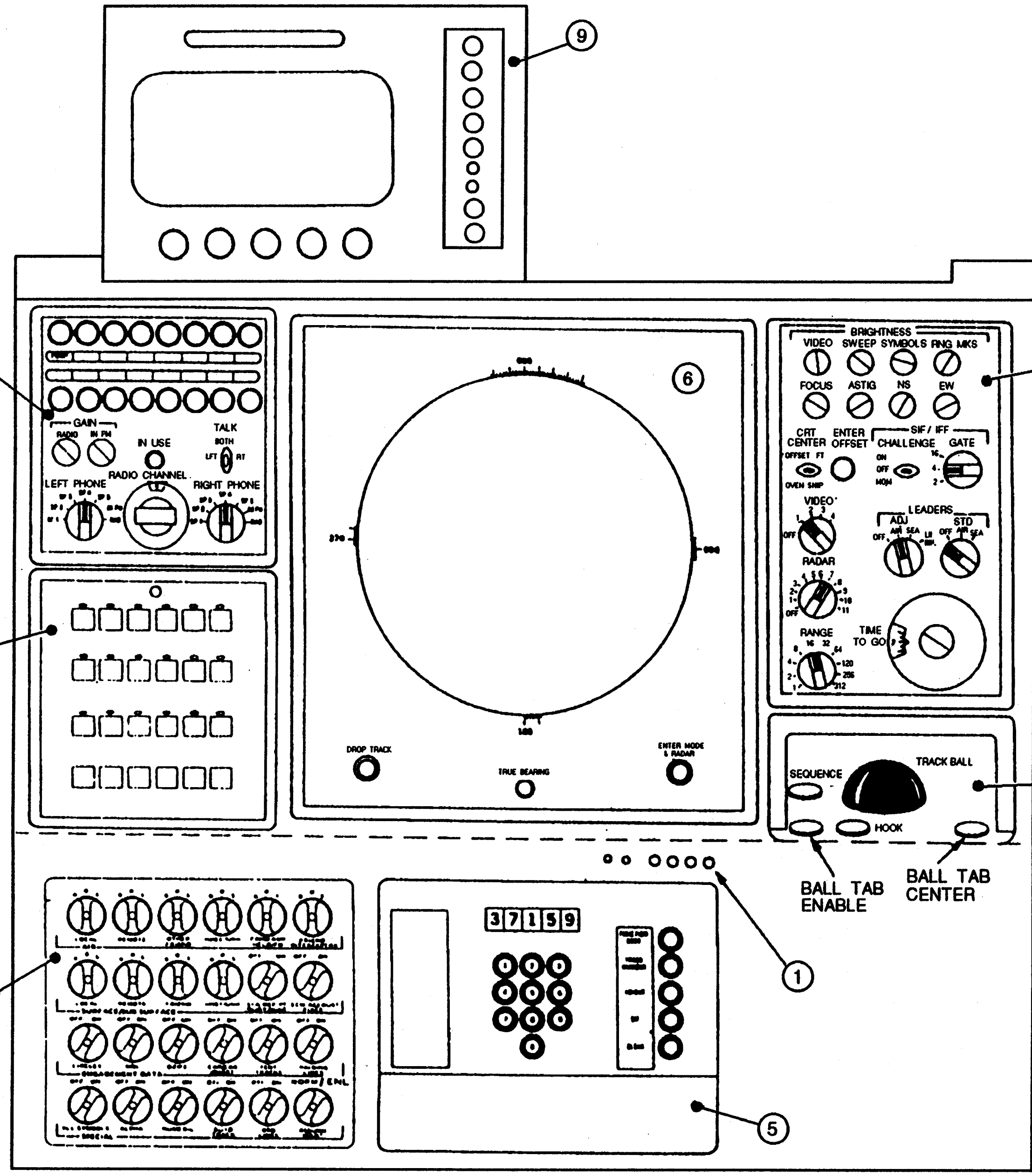


Figure 3-15.—A typical PPI display console.



① SECURE VOICE CONTROLS
② COMMUNICATIONS PANEL
③ COMPUTER CONTROLLED ACTION ENTRY
④ CATEGORY SELECT PANEL
⑤ DIGITAL DATA ENTRY UNIT
⑥ CRT PANEL
⑦ DISPLAY CONTROL PANEL
⑧ TRACK BALL ASSEMBLY
⑨ DIGITAL DISPLAY INDICATOR (UP TO TWO DDIs CAN BE INSTALLED)

DS43-16

Figure 3-16.—PPI console control panels.

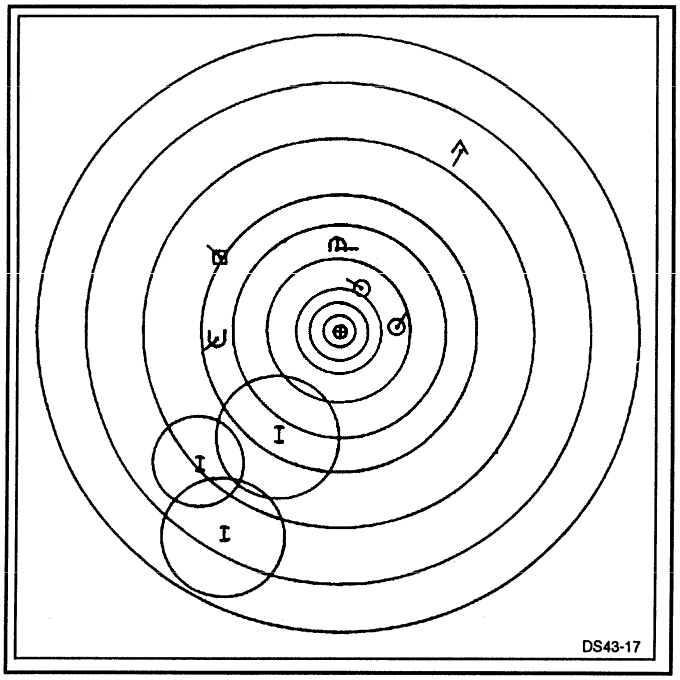


Figure 3-17.—A PPI tactical symbology display.

CRT CONTROL PANEL.— The CRT control panel contains the CRT, optional plotting board, and some of the controls for the console. The CRT displays tactical symbology as shown in figure 3-17. The CRT display of sensor data and symbology is controlled from the display control panel.

DISPLAY CONTROL PANEL.— The display control panel is located to the right of the CRT and contains the switches and controls to regulate the CRT display as shown in figure 3-18. The BRIGHTNESS section of the panel contains a potentiometer to control the display of video, sweep, symbols, and range marks. It also contains the potentiometer to control the CRT focus, astigmatism, and the centering adjustments.

Additionally, the display control panel contains the switches to select the radar, range of the radius of the CRT, select offset, and control symbol leaders.

DATA ENTRY PANELS.— For data entry purposes, the console is equipped with a computer-controlled action entry panel (CCAEP), and may be equipped with either a 6 by 7 panel or category select switch panel, a digital data entry unit, or an optional alphanumeric keyboard and a trackball unit. Figure 3-19 shows a console with the 6 by 7 panel and the alphanumeric keyboard. The trackball is recessed in the trackball well along with the ball tab enable, ball tab center, hook, and sequence pushbuttons.

Computer-Controlled Action Entry Panel (CCAEP).— The computer-controlled action entry panel (CCAEP) provides greater flexibility than its predecessor, the mode roller. CCAEPS consist of 24 switches arranged in 4 rows of 6 as shown in figure 3-20. The bottom row of six switches has fixed labels and functions. Each of the remaining 18 switch positions has 48 possible labels, or functions, independently controlled by computer output data and an auxiliary LED indicator.

The computer program controls the selection of a

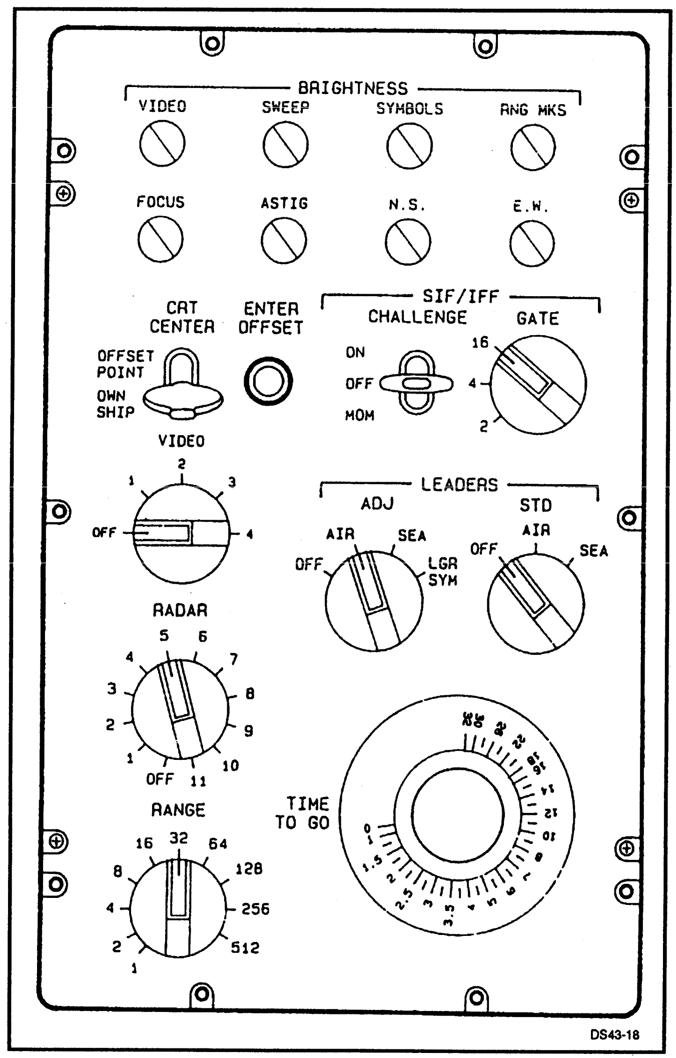


Figure 3-18.—A PPI display control panel.

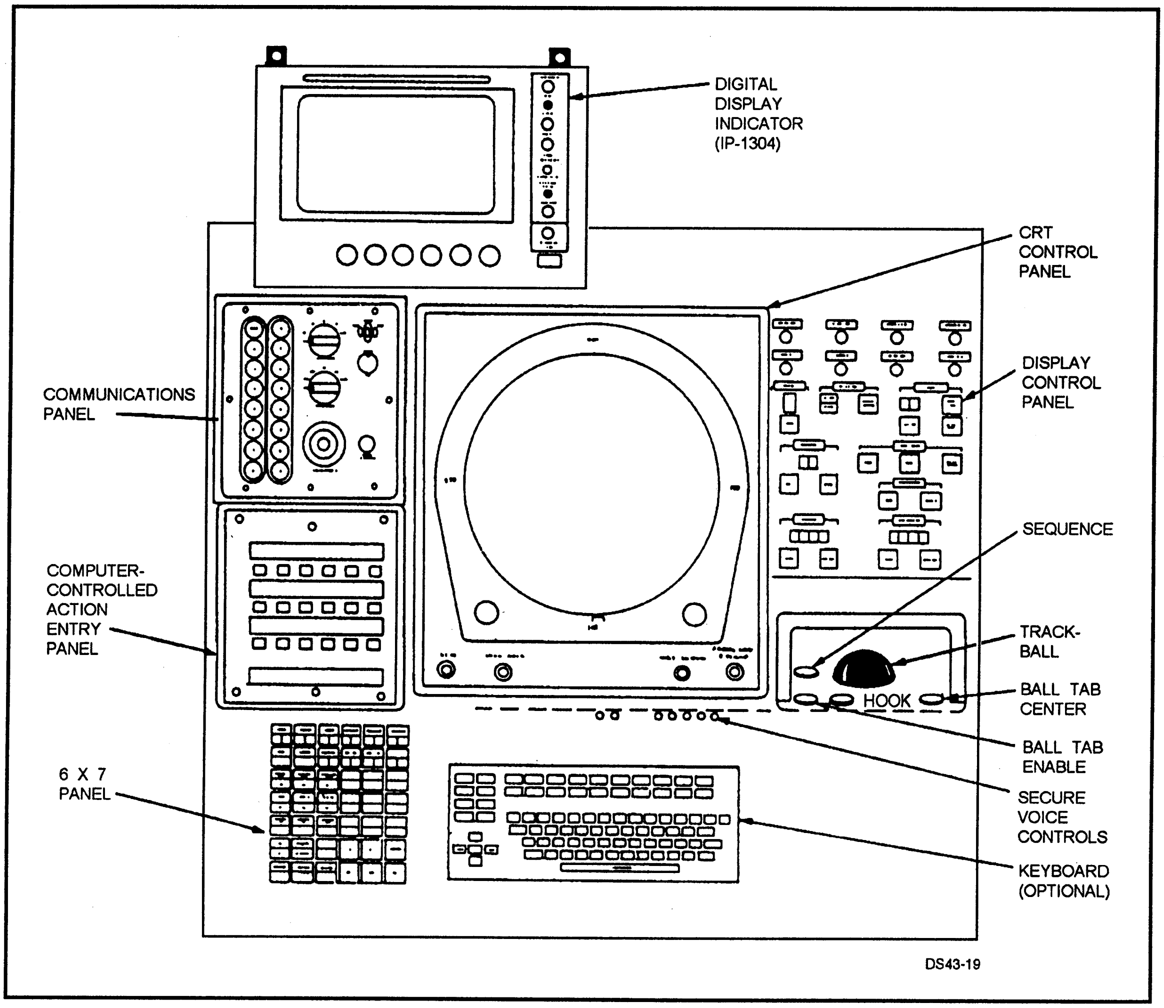


Figure 3-19.—A PPI equipped with a 6 x 7 panel and a keyboard.

label for each switch position on an individual basis. When depressed, each switch position generates a specific function code for computer input. A single LED indicator at the top of the panel is lighted to cue operator responses or to indicate reception of switch function codes.

A 6 by 7 Panel.— A 6 by 7 panel consists of 7 rows of 6 switches as shown in figure 3-21. When depressed, each of the 42 switches generates a specific function code for computer input. The 6 by 7 panel is used for category selection and as a data entry unit for numeric data. The top two rows of switches and the first three switches on the left in the remaining rows are used for category selection. The remaining switches are used as a number entry unit.

The category selection switches provide for independent console control of the symbology displayed at that console. The console operator can select the category of the symbols to be displayed on the console.

The number entry unit consists of a 10-digit keypad, a clear button, and four special-purpose buttons. Numerical entries from the keypad are displayed on the console CRT until one of the special-purpose buttons is depressed and the number entered is accepted by the computer program.

Alphanumeric Keyboards.— The alphanumeric keyboard installed in some consoles is a series of switches that inputs a code to the computer when a switch is depressed

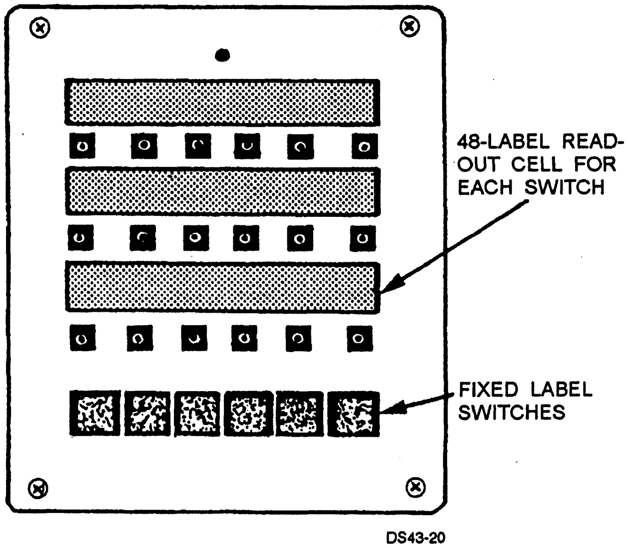


Figure 3-20.—Computer-controlled action entry panel.

Category Select Panel and Digital Data Entry Unit (DDEU).— Some display consoles use a category select panel and separate digital data entry unit. The category select panel is mounted on the left side of the bullnose and contains the 24 switches to control the display of symbols. The DDEU is mounted in the center of the bullnose and is used for numeric entry as described above for the 6 by 7 panel.

CONSOLE COMMUNICATIONS.— The console is provided access to three communications systems-interphone, sound-powered phone, or radio-via the console communications panel and the headset. The console communications panel is shown in figure 3-22.

Interphone.— Interphone links up to 15 consoles with voice and pointer symbol communications. This

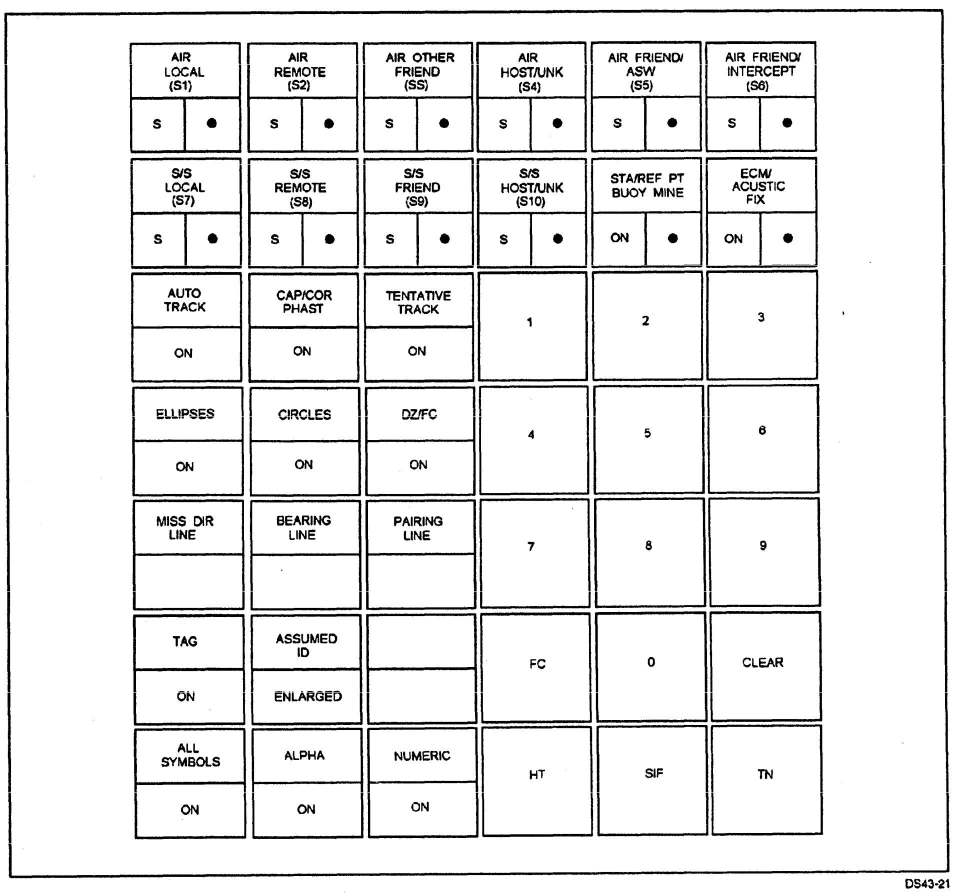


Figure 3-21.-A 6 x 7 panel.

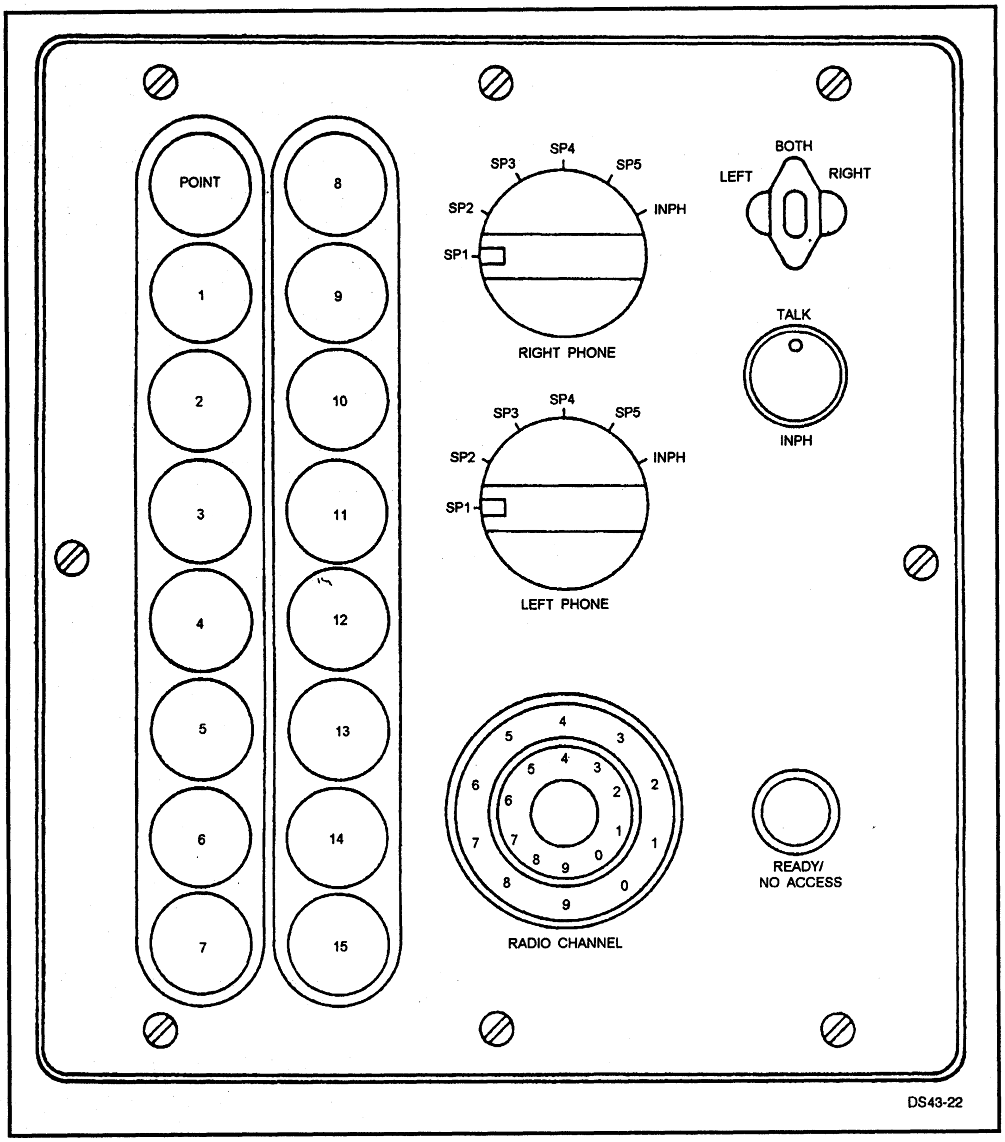


Figure 3-22.—A PPI console communications panel.

allows the console operators to communicate by voice with each other and identify locations or events on the CRT to each other using the pointer symbol.

Sound-Powered Phone.— Sound-powered phones tie the consoles into the ship's sound-powered communications network.

Radio.— Radio provides for ship-to-ship or ship-to-aircraft secure or nonsecure radio communication.

Console Functional Description

The display console is divided into two major functional areas: the digital area and the analog area. The digital area interfaces the console to the computer and the console operator. The analog area contains the deflection control logic and the intensity and focus control logic that drive the CRT display.

DIGITAL AREA.— The digital area receives computer output data, processes it, and outputs deflection and intensity (stroke) commands to the analog area. It also monitors console panel switch status and builds input words as switch status

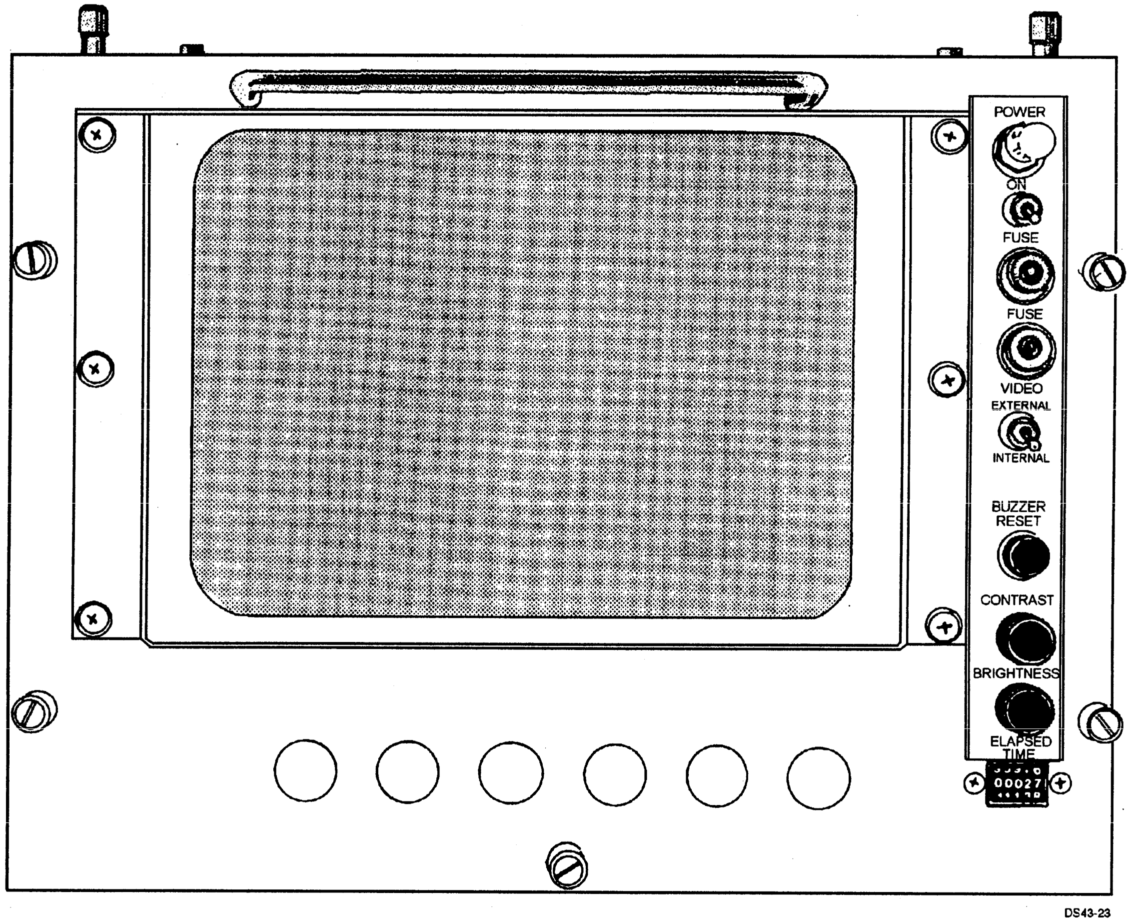


Figure 3-23.—Digita1 display indicator.

changes. It then transmits the input words to the CDS computer in response to interrogations.

ANALOG AREA.— The analog area receives ΔX and ΔY pulse trains, range marks, end-of-sweep, and video from the RDDS. This data is used to generate the sensor sweep and video display. The digital area of a CIGARS-equipped console provides the symbol control signals (SIGN X, X, 2X, SIGN Y, Y, 2Y, Z, and W) and offset data for sweep and symbology. In systems that use a symbol generator, symbol waveforms and unblinking signals are inputted directly into the analog section.

Digital Display Indicator (DDI)

The IP-1304/UYA-4(V) digital display indicator (DDI) shown in figure 3-23 is also called digital data indicator. It is a raster scan formatted video monitor. It accepts computer-generated alphanumeric (ASCII) and line display data, stores the data in an internal refresh (video) memory, and converts the stored data into monochrome raster scan video signals.

The DDI is capable of displaying sixteen 64-character lines (1,024 characters) in the internal video mode. The DDI is also designed to produce a 525-line TV display, from an external TV source, in the external video mode.

The DDI is an independent air-cooled, addressable monitor. It is may be mounted on top of the display console or in a stand-alone configuration as an auxiliary cathode readout (ACRO or CRO). It accepts data directly from the computer (DCI) or through the PA. When mounted on a console, the DDI is daisy chained with the console. The computer output data is routed through the DDI before going to the console digital area.

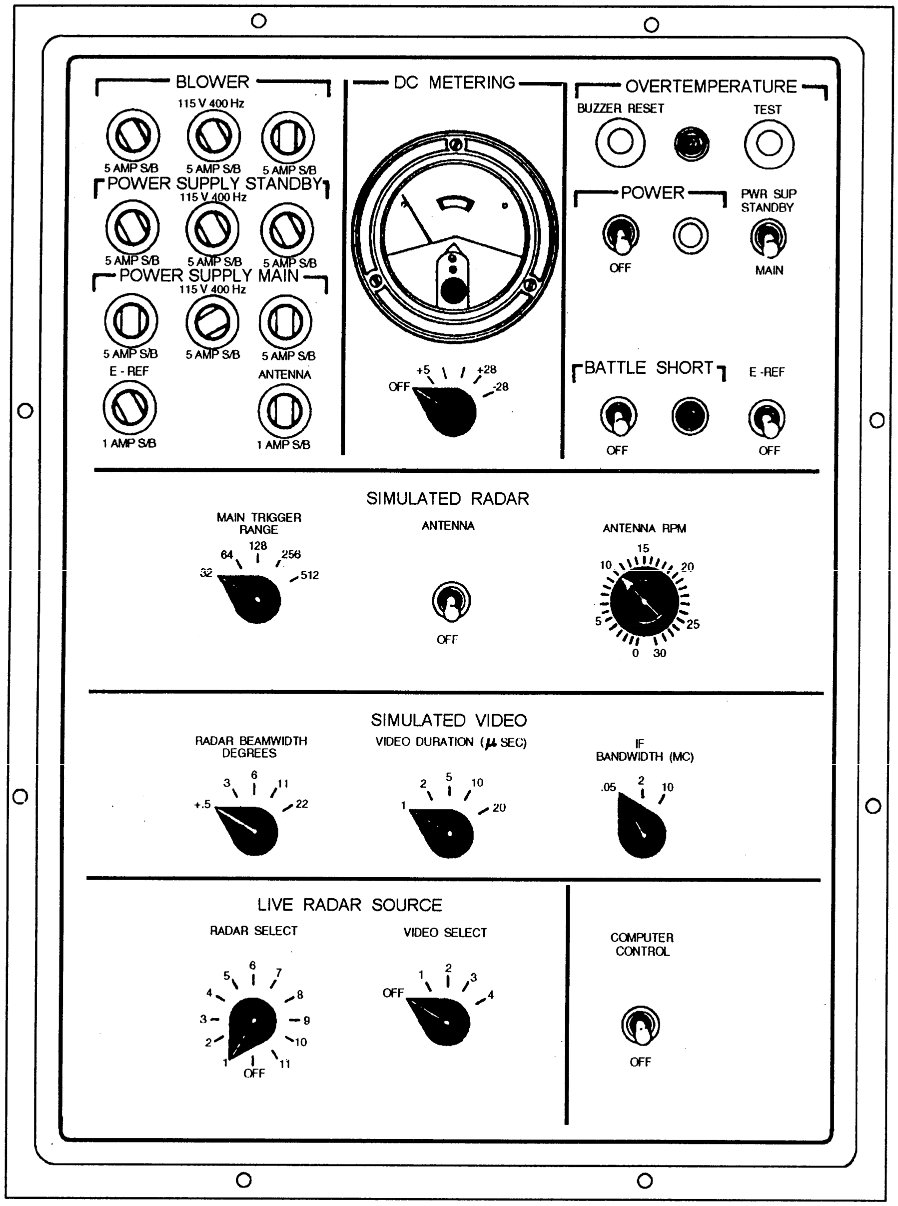


Figure 3-24.—VSS front panel.

DISPLAY SYSTEM SIMULATION AND TESTING

Most tactical display systems are able to simulate radar video and sweep signals for testing, troubleshooting, and operator training on the PPI consoles. In addition, there are computer programs (POFA/PEFTs) specifically designed to exercise the display consoles and verify their proper operation.

This section covers the devices and software used in tactical display systems to simulate the ship's radars and to test and troubleshoot the tactical display system.

VIDEO SIGNALS SIMULATOR (VSS)

The VSS develops simulated radar video and sweep signals for use in tactical display system testing, troubleshooting, and operator training. The VSS is used in place of or in conjunction with an operating two-dimensional radar. Simulated video and sweep signals of variable characteristics are used in the testing of RACs, RDDS, PPI consoles, and the operations summary console (OSC).

Use of the VSS makes it possible to monitor operator tracking accuracy. When used in conjunction with the operational program, the VSS can develop simulated tracking and tactical situations that resemble actual operations. Data extracted during these simulated exercises can be used to verify the accuracy of operator tracking and system operation.

The VSS is a computer-controlled device capable of generating antenna position data and triggers (sweep data), and radar video signals including simulated tracks, IFF/SIF, receiver noise, and sea clutter. Only the generation of video signals may be computer controlled; all other VSS functions are controlled from the VSS front panel, shown in figure 3-24.

Radar Sweep Simulation

The VSS can generate its own antenna position data or use a ship's radar as a source. If a ship's radar is used, the LIVE RADAR SOURCE switches are used to select the source radar and video level. The VSS then receives antenna position data and triggers from that radar's RAC via the RDDS. The antenna position data (digital azimuth) and triggers are used to determine the generation times for video signals.

The VSS contains its own synchro assembly, which generates synchro azimuth and triggers to the VSS RAC. The output of the VSS RAC is in turn fed back to the VSS via the RDDS for coincidence comparisons. The VSS simulated antenna rotation (RPM) and timing signals are controlled from the SIMULATED RADAR switches. To activate the servo assembly, both the E-REF and ANTENNA switches must be on.

Radar Video Simulation

The VSS receives video control data from the computer in message form. The output data defines the simulated video azimuth (bearing), range, and intensity. The VSS stores the output data in its track storage and compares the data with the digital azimuth and sweep data received from the RDDS. When the simulated video data and the digital sweep data are coincident, the VSS generates the ordered video signals and transmits them to the RDDS. Console selection of the VSS radar and video level allows display of VSS video and sweep.

The video output of the VSS is made up of three types of video: live video, live and simulated (mixed) video, and simulated video. The live video output is isolated from the simulator. The live and simulated output is made up of simulated tracks intermixed with live video passing through the VSS. Simulated video is made up of computer-generated video only.

Manual control of the simulated video characteristics is provided by the SIMULATED VIDEO switches. These switches allow the generated video to display characteristics that are similar to live radar video. The VIDEO DURATION (μSEC) switch controls the intensity (pulse length) of the simulated video return. The sharpness of the return is controlled by the IF BANDWIDTH switch. The sector width of the return is controlled by the RADAR BEAMWIDTH DEGREES control.

TEST MESSAGE GENERATOR (TMG)

The test message generator (TMG), shown in figure 3-25, is used to generate simulated computer output data for testing and troubleshooting display equipments. Normally contained in the PANG cabinet, the TMG is removable for its testing and troubleshooting role. The TMG maybe connected to the equipment under test by a jumper cable. This permits greater freedom of action for maintenance personnel in troubleshooting individual devices, such as a PPI console.

The TMG can simulate any desired computer output data message up to four data words in length. Coding of TMG data is controlled by word group switches on the TMG control panel.

The TMG is capable of operating in five different modes. The mode selection allows for great flexibility when testing or troubleshooting the display suite equipment.

Free Run Mode

The free run mode of operation repeats an operator-selected four-word message approximately every 400 microseconds. In this mode, the TMG may be used with any display equipment.

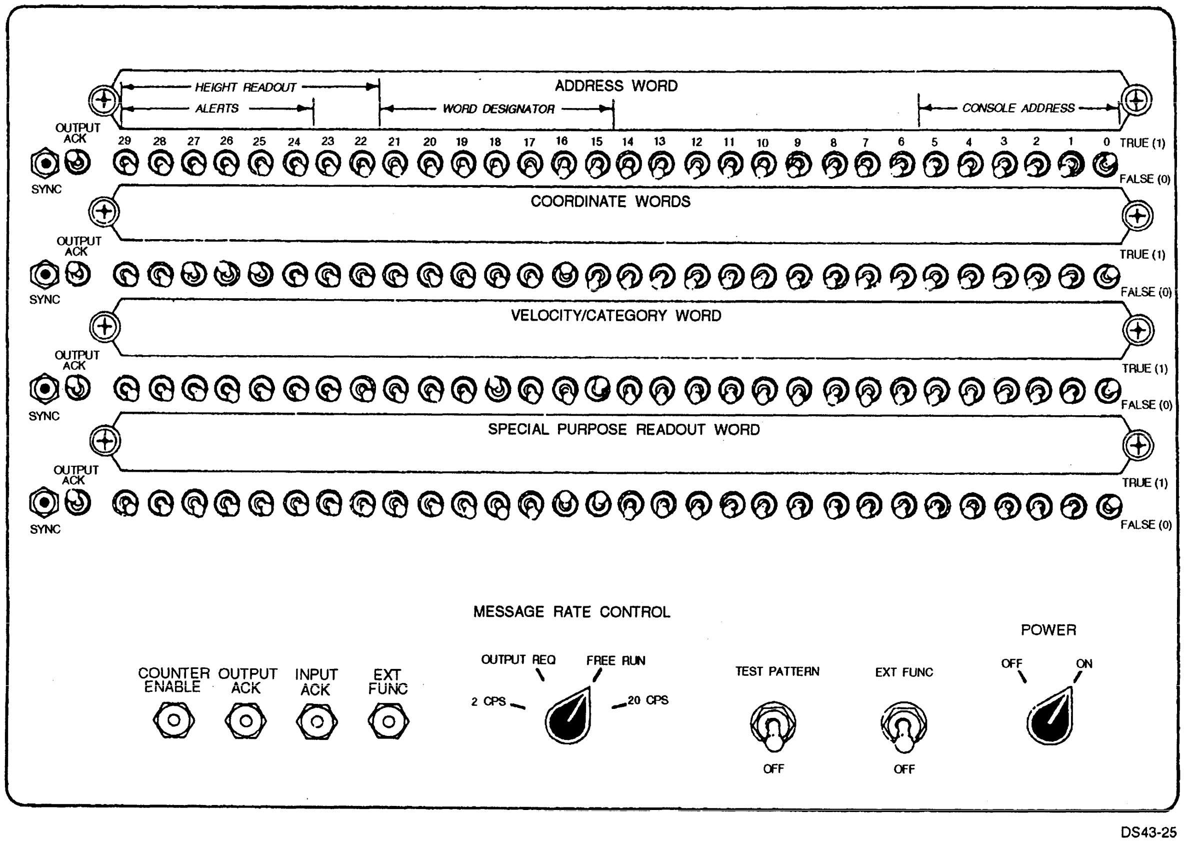


Figure 3-25.—Test message generator.

Test Pattern Mode

The test pattern mode of operation, used only when the TMG is installed in the PA cabinet, displays two symbols repeated every 90 degrees for a total of eight symbols. All the word designator bits and the TEST PATTERN switch must beset too btain this display. The test pattern is normally output to one group of consoles at a time.

Output Data Request (ODR) Mode

The output data request (ODR) mode of operation generates one data word in response to each ODR received from the equipment undervest. ODR mode is used when testing the PA, VSS, or consoles with DCI.

The 2/20 Cycles-Per-Second (CPS) Modes

The 2/20 cycles-per-second modes are a variation of the free run mode. The two-cycle mode repeats up to a four-word message twice a second (every 500 milliseconds). The 20-cycle mode repeats the message 20 times a second (every 50 milliseconds).

DISPLAY POFA/PEFT

A tactical display system is a somewhat complicated combination of equipments. The sheer number of consoles (PPIs), radar distribution switchboards, radar azimuth converters, pulse amplifier/symbol generators or PA/CIGARS or DCI/CIGARS tends to present a formidable maintenance task.

One of the primary tools available to the maintenance technician is the display programmed operational functional appraisal (POFA) and on some classes of ships, the display peripheral equipment functional test (PEFT).

Display POFA

The display POFA grouping of tests is designed to be loaded and run in the computer in lieu of the operational program. Display POFA subtests are designed to check particular functions of the display consoles and VSS. The display POFA is normally run on a group of consoles as part of the fault isolation process or as required by the planned maintenance system (PMS).

The display POFA subtests will vary from system to system, depending on the equipment configuration of the display suite. There are, however, several common functions normally tested. Switch function codes are checked; test patterns of symbols are displayed; the trackball/ball tab coordinates are verified; and various panel operations are exercised. The display POFA is designed to completely check all display capabilities.

Display PEFT

The display PEFT grouping of subtests is contained in the operational program. The display PEFT allows the operator or technician to verify the operation of a single console independent of the operational program in progress.

The display PEFT subtests are similar to the display POFA. However, the range of subtests is more limited in the PEFT. The display PEFT is designed to be run on a console in the event a console malfunctions during normal operations.

ELECTRONIC PLUG-IN CIRCUIT TEST SET

Tactical display systems are equipped with an electronic plug-in circuit test set. The test set, shown in figure 3-26, provides the technician with the facilities to test and repair faulty plug-in assemblies used in the display suite equipments.

The test set simulates normal operating conditions by providing operating power and loads to the assemblies under test. In addition, the test set provides test signals and monitoring facilities, which enable the technician to troubleshoot, test, and align faulty assemblies. Portable test equipment (oscilloscopes, vacuum tube voltmeters, and so forth) is used in conjunction with the test set.

SUMMARY—THE DATA DISPLAY GROUP AN/UYA-4(V)

This chapter has introduced you to the Data Display Group AN/UYA-4(V). The following information summarizes the important points you should have learned.

DATA DISPLAY GROUP— The purpose of any display system is to present a visual picture of the tactical situation. This allows the operator to make various decisions and take action. The heart of the display system is the plan position indicator (PPI), or display console. The PPI receives analog inputs from the ship's sensors (radar and sonar), digital or tactical data from the CDS computer, and simulated data from the video signals simulator (VSS) and test message generator (TMG). The simulated data from the VSS can be used for system testing or operator training.

SENSOR DATA DISTRIBUTION— Sensor data from the radar is received by the radar azimuth converter (RAC) and distributed to the PPIs by the radar data distribution switchboards.

RADAR AZIMUTH CONVERTER (RAC)— The RAC converts antenna position data to a form that the PPI can use. The azimuth data is sent to the PPI console as ΔX and ΔY pulse trains. The number of pulses in the pulse train represents the angle of the antenna, and the spaces between the pulses represent the range of the radar.

RADAR DATA DISTRIBUTION SWITCHBOARD (RDDS)— The RDDS provides amplifications of the radar video received from the radar and the azimuth data received from the RAC and distributes them to the PPI consoles.

TACTICAL DATA DISTRIBUTION AND DISPLAY— Tactical data is data generated by the CDS computer. Tactical data can be symbol data or amplifying information about a symbol. Depending on the system installed on your ship, the tactical data may be distributed through several different routes.

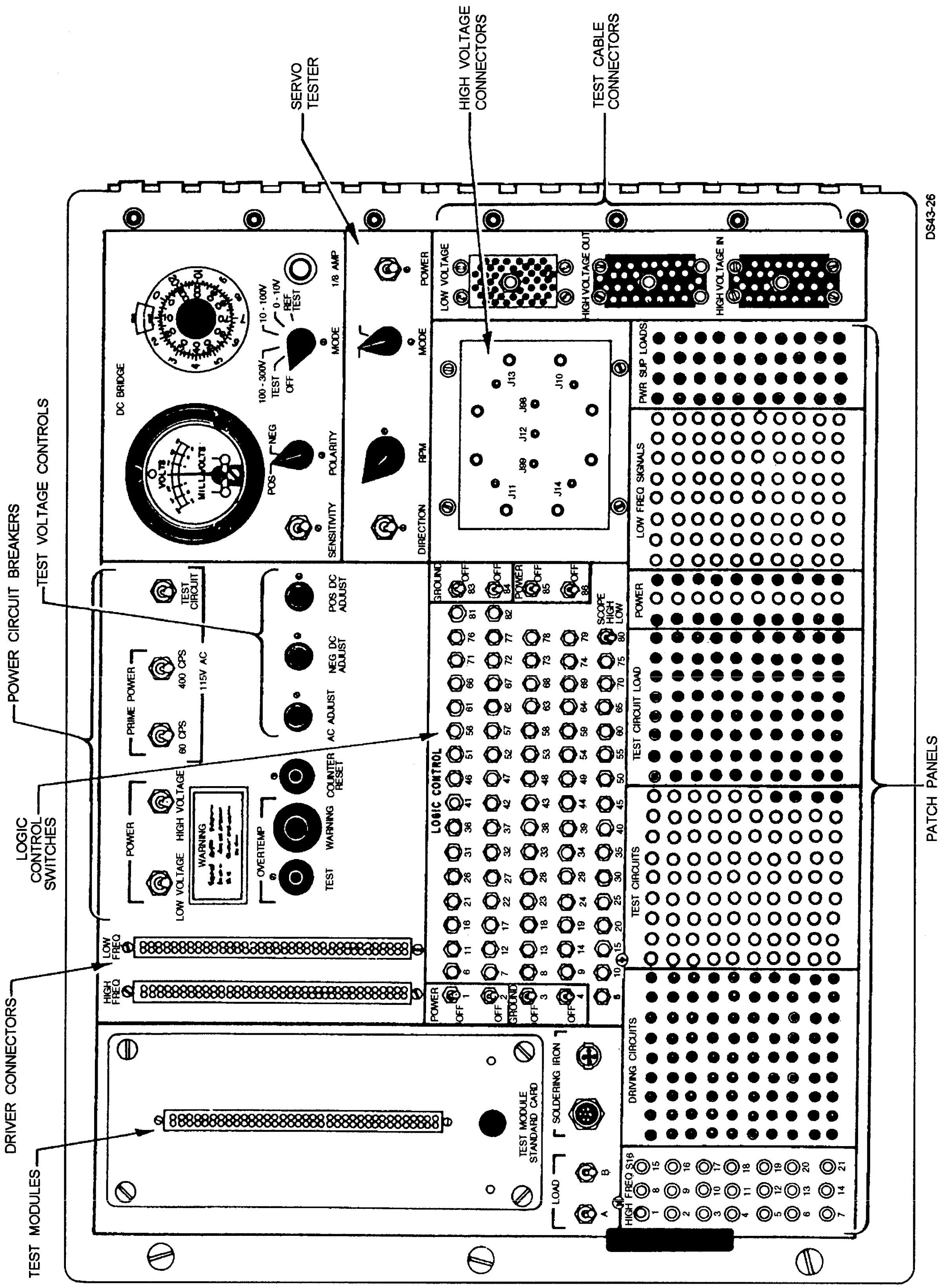


Figure 3-26.—An electronic plug-in test set.

PULSE AMPLIFIER/SYMBOL GENERATOR (PA/SG)— The PA/SG is really two pieces of equipment in one cabinet. The pulse amplifier provides amplification and distribution of computer data to the PPI consoles. The pulse amplifier also receives data from the PPI consoles for input to the computer. The symbol generator decodes data from the CDS computer and generates the symbol waveforms or stroke code to paint a symbol. Systems with PPI consoles that have the console internally generated and refreshed symbols (CIGARS) modification installed will not have a separate symbol generator. In these systems only, the pulse amplifier is installed. Systems with CIGARS modified PPI consoles that also have the direct computer interface (DCI) will not have either the pulse amplifier or symbol generator.

PLAN POSITION INDICATOR (PPI)— The PPI receives data from the RDDS and CDS computer and creates a visual display on a CRT. There are several models of the AN/UYA-4(V) PPI. The PPI also allows the operator to input data to the CDS computer.

DATA DISPLAY GROUP SIMULATION AND TESTING— The data display group allows for the generation of simulated video and radar signals using the video signals simulator (VSS) and offline testing of most equipment using the test message generator. Circuit card repair and alignment is accomplished using the electronic plug-in test set.

VIDEO SIGNALS SIMULATOR (VSS)— The VSS generates simulated video and radar signals for operator training and system troubleshooting. The VSS can generate simulated video using inputs from a ship's radar system and can mix simulated video with actual live video.

TEST MESSAGE GENERATOR (TMG)— The TMG allows the maintenance technician to input up to four computer words to paint symbols on the PPI consoles. This allows the operator to perform offline tests on each individual CIGARS equipped console or one display group.

ELECTRONIC PLUG-IN TEST SET— The electronic plug-in test set allows the technician to troubleshoot and align circuit cards and assemblies of the Data Display Group AN/UYA-4(V). Special adapters and cables allow the technician to control the signals applied to each pin of the card under test to isolate the faulty circuit.